

# SHORT COMMUNICATIONS

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## TICK PARASITISM AT NESTING COLONIES OF BLUE-FOOTED BOOBIES IN PERU AND GALAPAGOS<sup>1</sup>

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**Key words:** *Tick parasitism; Ixodoidea; Blue-footed Boobies; Sula nebowxi; Peru, Galápagos.*

### INTRODUCTION

Nesting congregations of animals provide reliable, dense concentrations of hosts for parasites (Rothschild and Clay 1952). In seabird colonies, high densities of ectoparasites, especially ticks (Ixodoidea), may lead to the death of young birds and the desertion of nests or even whole colonies (reviewed by Duffy 1983).

Different species of boobies and gannets (Sulidae) nest at a wide variety of densities (Nelson 1978). Peruvian Boobies (*Sula variegata*) and Cape Gannets (*Morus capensis*), with some of the highest nesting densities, can support very large tick populations (Duffy 1983; pers. observ.). We investigated aspects of tick infestation on Blue-footed Boobies (*S. nebowxi*) which nest at variable, but relatively low densities (Nelson 1978). We compared tick densities in nests of sympatric Blue-footed and Peruvian boobies on an island off Peru and examined tick population intensity on nestling Blue-footed Boobies at three sites in the Galápagos. We determined where ticks occurred on the bodies of nestlings of different ages, whether older nestlings had more ticks, and if tick intensities varied between colonies.

### METHODS

On Isla Lobos de Tierra, 06°28'S, 80°50'W, Peru, we compared counts of the argasid tick (*Ornithodoros amblyus*) (Clifford et al. 1980; Khalil and Hoogstraal 1981) from 0.5-liter scoop samples taken from material in ten Blue-footed Booby nests and five Peruvian Booby nests during daylight hours between 24 and 27 February 1979 (cf. Duffy 1983). The nests were in active use and situated well away from any areas of apparent desertions. Only nymphal and adult ticks were counted, since larvae were very small and mobile and easily overlooked (Duffy 1983).

The three Galápagos study sites were Vincente Roca 00°03'S, 91°39'W, Isla Isabela, visited on 25 July 1981; Caleta Iguana 00°57'S, 91°28'W, Isla Isabela, visited 27 July 1981; and Cabo Douglas 00°18'S, 91°40'W, Isla Fernandina, visited 26 July 1981. Visits were made between 0900 and 1600. At the three Galápagos colonies, we counted ticks (*O. yunkeri*; Keirans et al. 1984) on nestlings, since ten samples with 0.5-liter containers and random searching showed no evidence of ticks in the substratum. Most ticks not attached to birds tended to be clumped in wood debris or in rock crevices (cf. Rice 1977), making scoop samples useless as population indices. We assumed

that ticks on birds during daylight hours represented a constant proportion of the total tick populations.

Young boobies were carefully searched for ticks by moving or blowing aside contour and down feathers in order to examine the underlying skin. Feeding larval ticks, although themselves often inconspicuous, were surrounded by inflamed areas which were relatively easy to see. Adult ticks were larger than most nymphs and easier to count. Only total numbers were recorded, since field identification of life history stages of the ticks would have been time-consuming and we wished to avoid thermal stress to nestling boobies. Exact counts of ticks were made at Caleta Iguana but, because of lack of time, less precise counts were made at the other sites, using the following categories: <5; 6 to 10; 11 to 20; 21 to 50; 51 to 500; >500. Infrequently recorded categories were subsequently merged for analysis.

Young boobies were weighed and their culmens and wing chords measured to the nearest mm as part of a growth study (Ricklefs et al. 1984). Since the number of ticks per bird might be related to size of their hosts, we divided young boobies into three size-classes based on wing length (Duffy and Ricklefs 1981, Ricklefs et al. 1984): wing length: 20 to 80 mm (approximately 0 to 23 days); 80 to 200 mm (24 to 43 days); 200 to 500 mm (44 to 100 days).

At Caleta Iguana, we recorded where each tick was found on young boobies. We recognized four body areas: 1) the ventral area under the wings; 2) belly from breast to the tail, and the legs and feet; 3) the ventral surface of the wings; 4) the head, ventral surface of the neck, anterior to the breast, and the remainder of the body.

Several different measurements of tick populations are used in this paper: 1) mean abundance: number of ticks per parasitized host; 2) relative abundance: mean number of ticks per bird examined; 3) density: number of ticks per unit of sample examined.

Voucher specimens of ticks were collected and sent to Dr. Harry Hoogstraal, United States Naval Medical Research Unit 3, Cairo, Egypt, for species identification.

### RESULTS

#### TICK (*O. AMLUS*) DENSITIES ON LOBOS DE TIERRA

No ticks were found in 10 scoop samples taken from nests of Blue-footed Boobies. In five samples from Peruvian Booby nests, counts of adult ticks were 5, 7, 20, 1, 8 ( $\bar{x}$  = 8.2; SD = 7.1). Tick densities were even higher where Peruvian Boobies were deserting nests (Duffy 1983). Ticks could be seen on young Peruvian Boobies, even at nests where breeding appeared to be proceeding normally, but no ticks were observed on young Blue-footed Boobies.

#### TICK (*O. YUNKERI*) POPULATIONS IN RELATION TO AGE OF NESTLINGS

The relative abundance of ticks on 28 nestling Blue-footed Boobies at Caleta Iguana colony was significantly corre-

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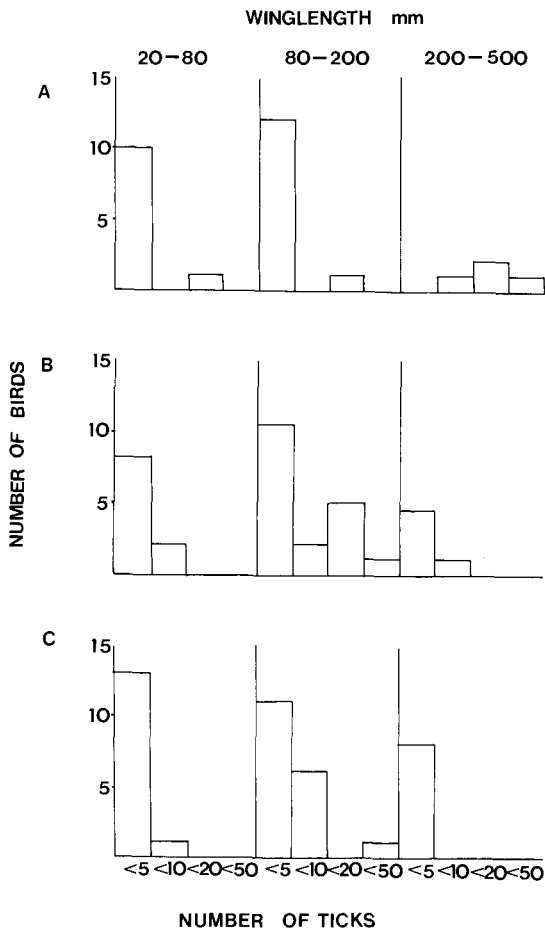


FIGURE 1. Tick population intensity on nestling Blue-footed Boobies from colonies at Caleta Iguana (A;  $n = 28$ ); Vicente Roca (B;  $n = 36$ ); and Cabo Douglas (C;  $n = 40$ ).

lated with wing length of nestlings ( $r_s = 0.455$ ;  $P < 0.01$ ;  $n = 28$ ; Spearman rank correlation with correction for ties, Siegel 1956:207). If only birds with ticks are included as a measure of the intensity of parasitism, the relationship with size remained significant ( $r_s = 0.547$ ;  $P < 0.05$ ;  $n = 15$ ).

#### TICK (*O. YUNKERI*) MEAN ABUNDANCE AT DIFFERENT COLONIES

The numbers of ticks per bird at the three Galápagos colonies were compared, using three size classes of young represented by wing lengths of 20 to 80 mm; 80 to 200 mm; and 200 to 500 mm. The mean intensity of ticks on the smallest-size class of young (wing lengths 20 to 80 mm) did not differ significantly between colonies (Fig. 1;  $\chi^2 = 0.813$ ,  $P > 0.05$ ,  $df = 2$ ; non-parametric test used because data were not normally distributed) but the two larger classes differed (80 to 200 mm:  $\chi^2 = 11.67$ ,  $P < 0.02$ ;  $df = 4$ ; 200 to 500 mm:  $\chi^2 = 13.84$ ,  $P < 0.001$ ;  $df = 2$ ).

#### DISTRIBUTION OF TICKS (*O. YUNKERI*) ON THE BODIES OF NESTLING BOOBIES

In the smallest size class (20 to 80 mm wing length, 0 to 23 days), most ticks were found on the ventral surfaces of the wing and neck. In the intermediate and largest classes (combined: 80 to 500 mm wing length, 23 to 100 days),

TABLE 1. The percent distribution of ticks on different parts of the bodies of nestling Blue-footed Boobies in relation to size of nestling, at Caleta Iguana, Isla Isabela, Galápagos.

Body area	Size classes of boobies (wing lengths)		
	40 to 80 mm	80 to 200 mm	200 to 500 mm
Under wing	50%	37%	32%
Upper wing	12.5	40	41
Belly, feet, and legs	12.5	13	17
Neck, head, and body	25	10	9
Number of ticks	16	30	65
Number of birds	12	12	4

most ticks were found on the dorsal and ventral wing surfaces, with the ventral neck area less important than earlier (Table 1). The change in location was not statistically significant ( $P > 0.05$ ;  $\chi^2 = 7.106$ ;  $df = 6$ ). A few ticks were present on the belly, but almost no ticks occurred on the feet or the rest of the body.

#### DISCUSSION

Nests of Blue-footed Boobies were consistently warmer than those of Peruvian Boobies on Isla Lobos de Tierra, because Peruvian Boobies nested only on windswept flat areas and Blue-footed Boobies tended to nest in less-windy areas. However, the difference in temperature was rarely more than 1°C (Duffy unpubl.). Peruvian Boobies nested at densities of 2.1 nests  $m^{-2}$  on Lobos de Tierra, but the densities of Blue-footed Boobies were less than 10% of this (unpubl. data). We suggest that the low tick mean abundances at Blue-footed Booby nests were a consequence of the species' lower nesting density rather than of its slightly warmer nests. Seasonal aspects of the life cycle of both ticks and boobies may also play a part. Blue-footed Boobies nest throughout the year, but breeding peaks are not predictable (Nelson 1978). Peruvian Boobies also nest throughout the year, but most activity occurs in spring (Vogt 1942). *Ornithodoros amblyus* may be able to synchronize its life cycle to coincide with peak breeding of the Peruvian Booby, but the irregular cycle of the Blue-footed Booby would prevent synchronization for *O. yunkereri* in Galápagos and *O. amblyus* in Peru, making it less likely to reach high population densities.

The relation between tick *O. yunkereri* numbers and body size of nestling Blue-footed Boobies in Galápagos may have resulted from four factors: age, body surface area, surface cover by feathers, and the relative attraction of brooding adults as hosts.

Surface area increases by a power of two compared to wing length; a greater surface area would allow more ticks to feed simultaneously. Second, young Blue-footed Boobies are not fully covered with down until three weeks of age (Nelson 1978:526). Subsequently, the increased skin-surface coverage by feathers would provide shelter from preening by young boobies or their parents and perhaps also protect from overheating of ticks by insolation. Third, if ticks 'colonize' booby nests with young or reproduce throughout the nestling stage, rather than already being present when booby eggs hatch, then the older the booby young, the longer the period available for additional ticks to arrive or be born. Fourth, adult boobies brood young almost continuously for the first two weeks after hatching (Nelson 1978). This might provide a more attractive food source to ticks because of the adults' heavier plumage. Young Blue-footed Boobies do not attain full homeothermy before 10 to 15 days (Duffy and Ricklefs 1981), and *Ornithodoros* ticks may prefer the warmer adults dur-

ing this period. Repeated sampling of nests would serve to determine the relative importance of these factors.

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## LACK OF EFFECTS FROM SAMPLING BLOOD FROM SMALL BIRDS<sup>1</sup>

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**Key words:** *Blood sampling; Gallus gallus; Northern Bobwhite; Colinus virginianus; House Sparrow; Passer domesticus.*

Blood samples are desirable for many types of ornithological studies. For example, electrophoresis of proteins found in blood can provide valuable information on population and breeding structure. Because such research often requires nondestructive sampling, it is necessary to know what effect blood sampling has on birds. I conducted a series of experiments to evaluate the effects of taking blood from small birds. Previous studies have used mortality of free-ranging birds as an indicator of stress (Kerlin and Sussman 1963, Raveling 1970, Utter et al. 1971, Bigler et al. 1977, Gowaty and Karlin 1984). I used change in body weight of captive birds as a more sensitive indicator of stress. Three species were tested: domestic broiler chicks (*Gallus gallus*), Northern Bobwhite chicks (*Colinus virginianus*), and adult House Sparrows (*Passer domesticus*).

I used five treatments to test for effects. In Treatment 1, birds were weighed only. In Treatment 2, the brachial vein of the left wing was punctured but blood was not drawn, thus testing for possible complications due to infection but not due to withdrawal of blood. In Treatment

3, a complete blood sample was drawn from the brachial vein in the left wing. One half of the complete blood sample was drawn from each wing in Treatment 4. Clotting could occasionally prevent blood from being drawn from one wing, and sampling from two wings could increase the chance for infection or other complications. In Treatment 5, the complete blood sample was taken from the left wing, and the fifth primary was plucked from each wing to obtain additional tissue from pulp present in the feather shaft. Twenty-five chickens and quail and 15 to 17 sparrows were randomly assigned to each treatment group. Broiler and quail chicks were obtained from breeders immediately after hatching. Adult House Sparrows were captured in June and July using mist nets and traps. Each bird was banded for individual identification.

Broiler chicks were weighed 24 hr after hatching, and on each of the next six days. Blood samples were drawn when chicks were five days old (av. wt. 113.9 g). Bobwhite chicks were weighed 11 days after hatching and then every other day for the next 14 days. Blood was drawn at age 15 days (av. wt. 50.3 g). House Sparrows were weighed on the day of capture and every other day for the next 12 days. Blood was taken on the sixth day of confinement (av. wt. 25.6 g).

Bobwhites and chickens were held separately as groups in two large pens and subjected to similar environmental conditions. House Sparrows were held in five 1 m × 1 m × 0.5 m cages with flexible plastic mesh siding. Broiler and bobwhite chicks were easily captured, but the spar-

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